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13. ABSTRACT (Maximum 200 words)

The year-long mooring records in the Arabian Sea (15°30'N/61°30E) show clearly the semi-annual biological response to the northeast and southwest monsoons. Each monsoon causes the mixed layer to deepen, but for the northeast monsoon, convective processes dominate, while during the southwest monsoon, the mixed layer deepens via wind-induced mixing. During both mixing periods, chlorophyll declines, and then increases as the water column stratifies. The annual cycle of chlorophyll variability at the mooring site (the climatological center of the Findlater Jet) generally follows the mixed layer depth. Strong diel variability in phytoplankton and particle variables were observed, and coherence analysis indicated that these were modulated more by water column processes (e.g., changes in the mixed layer depth) than by solar variability. We have demonstrated the utility of moored sensor systems in an unforgiving environment. The high-resolution data are extremely useful to those trying to understand the drivers for seasonal variability in productivity. The seasonal variability in productivity is crucial to interpret the export of carbon from the surface ocean to depth. The results will fuel consideration of the importance of diel processes in determining the activities of plankton.

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MOORED OBSERVATIONS FOR THE FORCED UPPER OCEAN DYNAMICS EXPERIMENT IN THE ARABIAN SEA

Award # N00014-94-1-0450

Final Report

submitted by

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The scientific objectives of this grant were to (1) determine the diurnal, within-season, and seasonal variability of phytoplankton for a locale subject to strong seasonal wind-stress; (2) understand how POC:Chl changes with the advent of the SW monsoon; (3) determine whether the seasonal increase in phytoplankton affects the surface heating of the water column; and (4) determine whether the chlorophyll-specific primary production is constant through the year in the Arabian Sea, where strong seasonal signals in nutrients are characteristic.

The work completed for this grant is as follows:

1. We completed two data reports, one for each deployment (Ho et al., 1996a, 1996b), and contributed to a preliminary results article for EOS (Rudnick et al., 1997).
2. We made presentations of data at the Arabian Sea Workshop in July, 1997.
3. We have several manuscripts (published or in press) in Deep-Sea Research-II Special Volume on the Arabian Sea Expedition (Marra et al., 1998; Kinkade et al., 1999a,b), and were co-authors on three other manuscripts.

The year-long mooring records show clearly the semi-annual biological response to the northeast and southwest monsoons. Interestingly, prior to each mixed-layer deepening associated with the monsoons, there is evidence of mesoscale eddies passing the mooring site, and which contain enhanced quantities of chlorophyll. Each monsoon causes the mixed layer to deepen, but for the northeast monsoon, convective processes dominate, while during the southwest monsoon, the mixed layer deepens via wind-induced mixing. During both mixing periods, chlorophyll declines, and then increases as the water column stratifies. The annual cycle of chlorophyll variability at the mooring site (the climatological center of the Findlater Jet, 15°30'N/61°30E) generally follows the mixed layer depth. When the mixed layer is deep, the quantity of chlorophyll in the water column is low, and increases when the mixed layer shallows following the cessation of monsoon winds. Prolonged stratification, during the intermonsoons, also results in declines in photosynthesis.

The variability in productivity over the year generally follows the change in chlorophyll except where there may have been changes to community structure (Feb-Mar, '95), or when grazing might be important (May, July, '95). Strong diel variability in phytoplankton and particle variables were observed, and coherence analysis indicated that these were modulated more by water column processes (e.g., changes in the mixed layer depth) than by solar variability (Kinkade et al.,1999a).

We have demonstrated the utility of moored sensor systems in an unforgiving environment. The high-resolution data are extremely useful to those trying to understand the drivers for seasonal variability in productivity. The seasonal variability in productivity is crucial to interpret the export of carbon from the surface ocean to depth. The results will fuel consideration of the importance of diel processes in determining the activities of plankton. We now have a better idea of the relationships among phytoplankton production, nutrient supply, and changes in mixed layer depth. The importance of mesoscale processes in distributing heat and momentum was demonstrated over a large part of the study area, and is probably the reason why productivity can remain relatively high despite the extreme variability in wind-forcing.

During this project we have developed a low-cost, compact, easy-to-use moorable spectro-radiometer with 32 wavelengths. It should find a variety of uses. Four companies sell in situ fluorometers which had a basis in design developed for a predecessor mooring program, Biowatt-II (1986-1988). I think that the efforts by both LDEO and UCSB (see T. Dickey et al., 1998) have had something to do with the use of chlorophyll fluorescence measurements at sea.

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